Stoller
Grand Junction Office established 1959

299-E25-XX (B8826)
Log Data Report

Borehole Information:

Borehole: 299-E25-XX (B8826)			**Site:** 216-A-29 Ditch		
Coordinates (WA State Plane)		**GWL (ft)[1]:** Not reached		**GWL Date:**	4/17/2003
North	**East**	**Drill Date**	**TOC[2] Elevation**	**Total Depth (ft)**	**Type**
N/A[3]	N/A	April 2003	N/A	273	Cable Tool

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
Threaded Steel	0.5	10 3/4	9 1/4	0.75	0	47.5
Threaded Steel	2.7	8 5/8	7 5/8	0.50	0.0	259.1
Threaded Steel	3.4	6 15/16	5 15/16	0.50	0.0	269.0
The driller provided the casing diameters and depths. The stick ups were measured.						

Borehole Notes:

Zero reference is the ground surface. The driller encountered perched water at approximately 258 ft and noted clay beneath.

Logging Equipment Information:

Logging System:	Gamma 2E		**Type:** 70% HPGe (34TP40587A)
Calibration Date:	03/2003	**Calibration Reference:**	GJO-2003-430-TAC
		Logging Procedure:	MAC-HGLP 1.6.5, Rev. 0

Logging System:	Gamma 2F		**Type:** Moisture (H380932510)
Calibration Date:	10/2002	**Calibration Reference:**	GJO-2002-387-TAC
		Logging Procedure:	MAC-HGLP 1.6.5, Rev. 0

Spectral Gamma Logging System (SGLS) Log Run Information:

Log Run	1	2/Repeat	3	4/Repeat	
Date	4/08/03	4/08/03	4/16/03	4/16/03	
Logging Engineer	Pearson	Pearson	Pearson	Pearson	
Start Depth (ft)	50.0	7.0	261.0	68.0	
Finish Depth (ft)	0.0	2.0	47.0	47.0	
Count Time (sec)	100	100	100	100	
Live/Real	R	R	R	R	
Shield (Y/N)	N	N	N	N	
MSA Interval (ft)	1.0	0.5	1.0	1.0	
ft/min	n/a[4]	n/a	n/a	n/a	

Log Run	1	2/Repeat	3	4/Repeat	
Pre-Verification	BE016CAB	BE016CAB	BE022CAB	BE022CAB	
Start File	BE016000	BE016051	BE022000	BE022215	
Finish File	BE016050	BE016061	BE022214	BE022236	
Post-Verification	BE016CAA	BE016CAA	BE022CAA	BE022CAA	
Depth Return Error (in.)	0.0	0.0	n/a	0.25 low	
Comments	Adjusted fine-gain after file: BE016036	No fine-gain adjustments.	No fine-gain adjustments.	No fine-gain adjustments.	

Log Run	5	6/Repeat			
Date	4/18/03	4/18/03			
Logging Engineer	Pearson	Pearson			
Start Depth (ft)	270.0	267.0			
Finish Depth (ft)	258.0	262.0			
Count Time (sec)	100	100			
Live/Real	R	R			
Shield (Y/N)	N	N			
MSA Interval (ft)	1.0	1.0			
ft/min	n/a	n/a			
Pre-Verification	BE025CAB	BE025CAB			
Start File	BE025000	BE025013			
Finish File	BE025012	BE025018			
Post-Verification	BE025CAA	BE025CAA			
Depth Return Error (in.)	n/a	1.0 low			
Comments	No fine-gain adjustments.	No-fine gain adjustments.			

Neutron-Moisture Logging System (NMLS) Log Run Information:

Log Run	1	2/Repeat	3	4/Repeat
Date	4/08/03	4/08/03	4/16/03	4/16/03
Logging Engineer	Pearson	Pearson	Pearson	Pearson
Start Depth (ft)	0.0	2.0	47.0	210.0
Finish Depth (ft)	50.25	7.25	261.0	231.0
Count Time (sec)	n/a	n/a	n/a	n/a
Live/Real	n/a	n/a	n/a	n/a
Shield (Y/N)	N	N	N	N
MSA Interval (ft)	n/a	n/a	n/a	n/a
ft/min	1.0	1.0	1.0	1.0
Pre-Verification	BF040CAB	BF040CAB	BF045CAB	BF045CAB
Start File	BF040000	BF040201	BF045000	BF045857
Finish File	BF040200	BF040221	BF045856	BF045941
Post-Verification	BF040CAA	BF040CAA	BF045CAA	BF045CAA
Depth Return Error (in.)	n/a	0.0	n/a	2.0 high
Comments	No fine-gain adjustments.		No fine-gain adjustments.	

Log Run	5	6/Repeat		
Date	4/18/03	4/18/03		
Logging Engineer	Pearson	Pearson		
Start Depth (ft)	258.0	262.0		
Finish Depth (ft)	270.0	267.0		
Count Time (sec)	n/a	n/a		
Live/Real	n/a	n/a		
Shield (Y/N)	N	N		
MSA Interval (ft)	n/a	n/a		
ft/min	1.0	1.0		
Pre-Verification	BF047CAB	BF047CAB		
Start File	BF047000	BF047049		
Finish File	BF047048	BF047069		
Post-Verification	BF047CAA	BF047CAA		
Depth Return Error (in.)	n/a	1.5 high		
Comments	No fine-gain adjustments.	Repeat log run.		

Logging Operation Notes:

Zero reference was the ground surface. This borehole was logged in stages through a single string of drill pipe before the casing was downsized and the borehole deepened. Logging was performed with a centralizer installed on the sonde.

SGLS data were collected using Gamma 2E. Pre- and post-survey verification measurements employed the Amersham KUT (^{40}K, ^{238}U, and ^{232}Th) verifier with serial number 082. On 4/08/2003, the repeat survey was performed using 0.5-ft samples to characterize a zone of ^{137}Cs.

Analysis Notes:

Analyst:	Sobczyk	Date:	4/28/03	Reference:	GJO-HGLP 1.6.3, Rev. 0

SGLS pre-run and post-run verification spectra were collected at the beginning and end of the day and compared to the control limits established on April 10, 2003. The verification spectra were all within the control limits except for post-run verification spectrum BE016CAA and pre-run verification spectrum BE025CAB. BE016CAA was above the upper control limit for the 609-keV peak counts per second (cps). BE025CAB was above the upper control limit for the 609-keV and 1461-keV full-width at half-maximum values. The peak counts per second at the 609-keV, 1461-keV, and 2615-keV photopeaks on the post-run verification spectra as compared to the pre-run verification spectra for each day were within 7 percent. Examinations of spectra indicate that the detector functioned normally during all of the logging runs, and the spectra are provisionally accepted.

NMLS pre-run and post-run verification spectra were collected at the beginning and end of the day and compared to the control limits established on 12/05/2002. The verification spectra were all within the control limits except for spectrum BF047CAB. This pre-run verification spectrum registered 770 cps, which is above the upper control limit of 735 cps.

SGLS log spectra were processed in batch mode using APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Verification spectra were used to determine the energy and resolution calibration for processing the data using APTEC SUPERVISOR. Concentrations were calculated in EXCEL (source file: G2EMar03.xls), using parameters determined from analysis of recent calibration data. Zero reference was the ground surface. On the basis of measurements supplied by the driller, the casing configuration was assumed to be one string of 10-in. casing to 47.5 ft and open hole below 47.5 ft

for the first and second logging runs. For the third and fourth logging runs, the casing configuration was assumed to be one string of 8-in. casing to 259.1 ft and open hole below 259.1 ft. For the fifth and sixth logging runs, one string of 6-in. casing to 269 ft was assumed. Below 269 ft, open hole was logged to a depth of 271 ft. The casing correction factor was calculated using casing thicknesses of 0.75 in. for the 10-in. casing and 0.5 in. for the 8-in. and 6-in. casings. Because the borehole was logged in stages, the casing correction is not additive; the borehole was logged through one string of casing during each logging run. However, the ends of logging runs 3 and 5 were run in a dual string of pipe and the casing correction is additive. Dead time and water corrections were not needed or applied to the data.

NMLS log spectra were processed in batch mode using APTEC SUPERVISOR to determine count rates. Zero reference was the ground surface. Calibration data are not available for the 10-in. casing, and the volume fraction of water was not calculated.

Log Plot Notes:

Separate log plots are provided for gross gamma and dead time, gross gamma and neutron total counts, naturally occurring radionuclides (^{40}K, ^{238}U, and ^{232}Th), and man-made radionuclides. Plots of the repeat logs versus the original logs are included. For each radionuclide, the energy value of the spectral peak used for quantification is indicated. Unless otherwise noted, all radionuclides are plotted in picocuries per gram (pCi/g). The open circles indicate the minimum detectable level (MDL) for each radionuclide. Error bars on each plot represent error associated with counting statistics only and do not include errors associated with the inverse efficiency function, dead time correction, or casing correction. These errors are discussed in the calibration report. A combination plot is also included to facilitate correlation. The ^{214}Bi peak at 1764 keV was used to determine the naturally occurring ^{238}U concentrations on the combination plot rather than the ^{214}Bi peak at 609 keV because it is less affected by the presence of radon in the borehole.

Results and Interpretations:

^{137}Cs was the only man-made radionuclide detected in this borehole. ^{137}Cs was detected near the ground surface (3 ft through 6.5 ft) at concentrations ranging from 0.5 to 62 pCi/g. The maximum concentration was measured at 5 ft. ^{137}Cs was also detected at 62 ft, 98 ft, 152 ft, and 243 ft with a concentration near its MDL of approximately 0.2 pCi/g. The ^{137}Cs detected at 62 ft did not repeat, but ^{137}Cs with a concentration near the MDL was detected at 56 ft during the repeat log between 68 and 47 ft.

Between 30 ft and 1 ft, ^{238}U (609-keV) concentrations are about 1/2 pCi/g higher than those based on the 1764-keV photopeak. This behavior suggests that radon may be present inside the borehole casing. The effects of radon on borehole logging are described in GJO-HGLP 1.6.3, Rev. 0 (2003).

The presence of radon is not an indication of man-made contamination; it is derived from decay of naturally occurring uranium. As a gas, radon moves easily in the subsurface, and concentrations of radon and its associated progeny can change quickly.

The plots of the repeat logs demonstrate reasonable repeatability of the SGLS and NMLS data. The natural radionuclides at energy levels of 1461, 1764, and 2614 keV are comparable between the repeat and original SGLS log runs. ^{238}U concentrations based on the 609-keV photopeak are about 0.5 pCi/g higher on the first repeat log run (7.0 to 2.0 ft) than those on the original log run. This change is caused by the build-up of radon in the borehole. ^{137}Cs (based on the 662-keV photopeak) concentrations on the repeat log run (7.0 to 2.0 ft) define the ^{137}Cs distribution better than the original log run because of the finer 0.5-ft sample interval on the repeat log run versus the coarser 1-ft sample interval on the original log run. The repeat log between 68 and 47 ft did not detect ^{137}Cs at 62 ft. The total neutron counts per second and its repeats are within the acceptance criteria.

Recognizable changes in the KUT and total gamma logs occurred in this borehole. At 5 ft, there is a 4-pCi/g decrease in ^{40}K concentration and a 0.3-pCi/g decrease in ^{232}Th concentration. In the interval from 56 to 61 ft, there is a 4-pCi/g increase in ^{40}K concentration. Between 215 and 221 ft, ^{232}Th concentrations

increase by about 0.4 pCi/g, and there is a 50-cps increase in the neutron-moisture. At 225 ft, there is a 5-pCi/g decrease in ^{40}K concentration. In the interval from 257 to 264 ft, there is a 0.4-pCi/g increase in ^{238}U and ^{232}Th concentrations, and there is a 100-cps increase in the neutron-moisture. This zone corresponds with the perched water with clay underneath that was observed by the driller.

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[1] GWL – groundwater level
[2] TOC – top of casing
[3] N/A – not available
[4] n/a – not applicable

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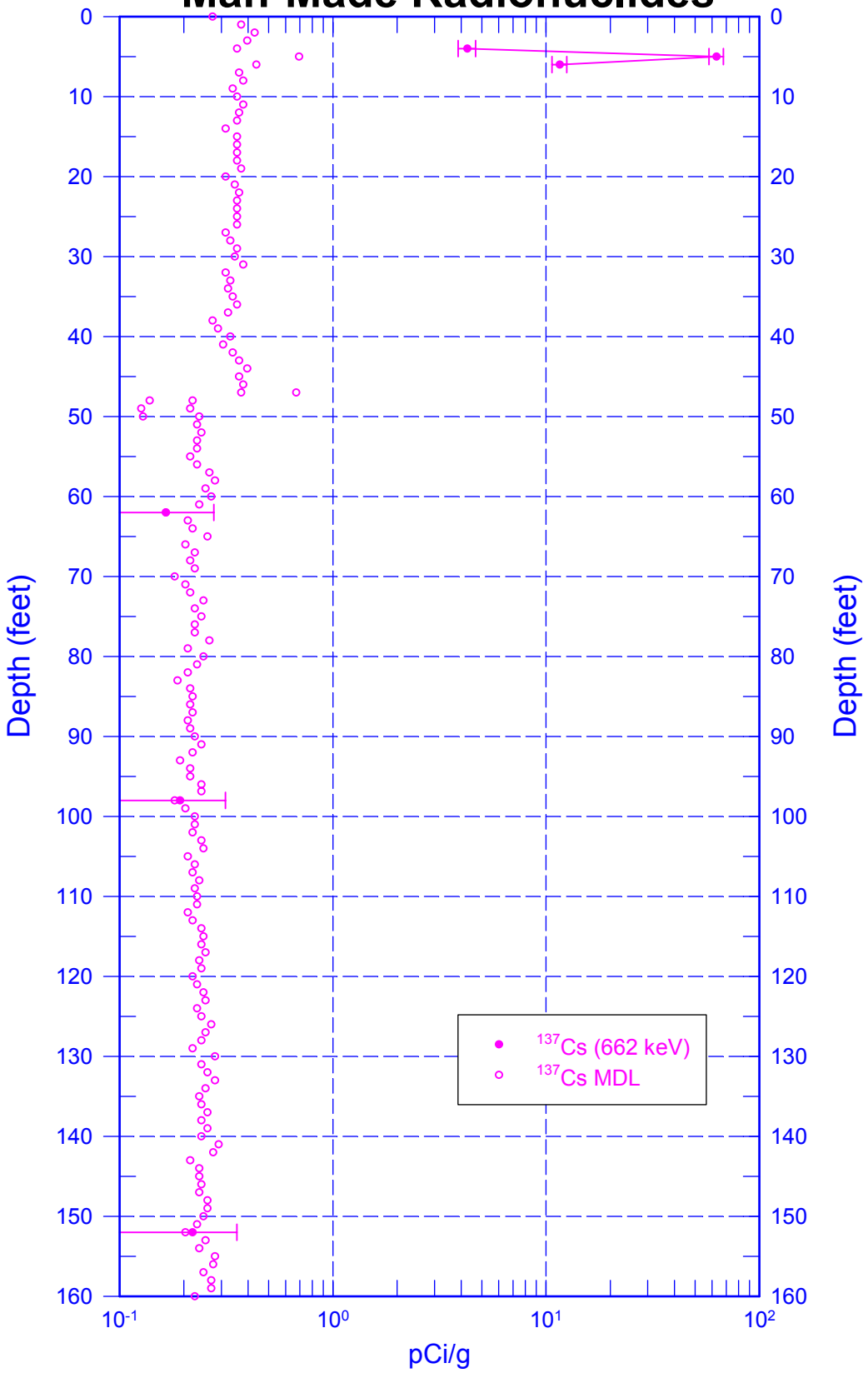
Man-Made Radionuclides



Zero Reference = Ground Surface

Date of Last Logging Run
4/16/2003

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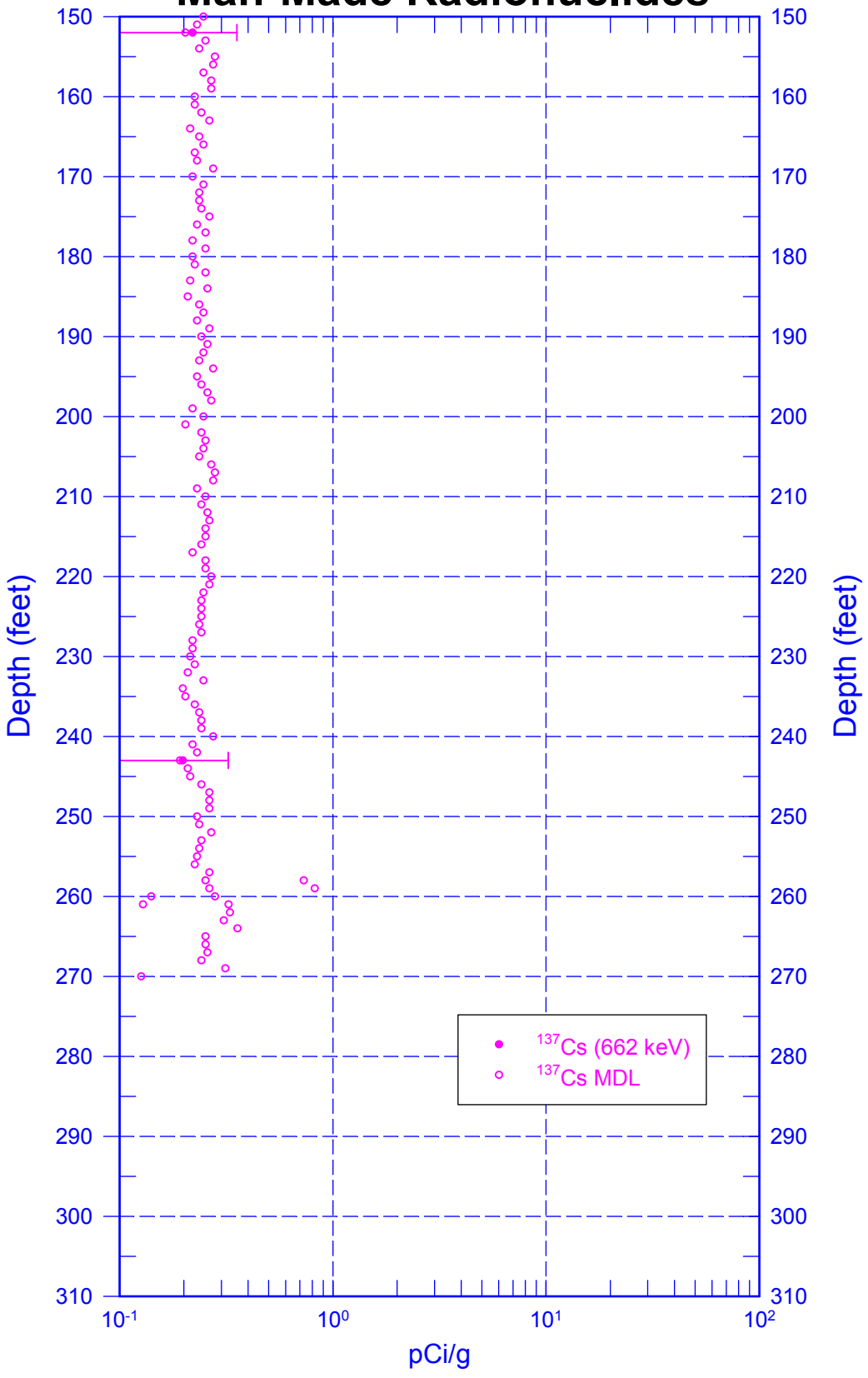
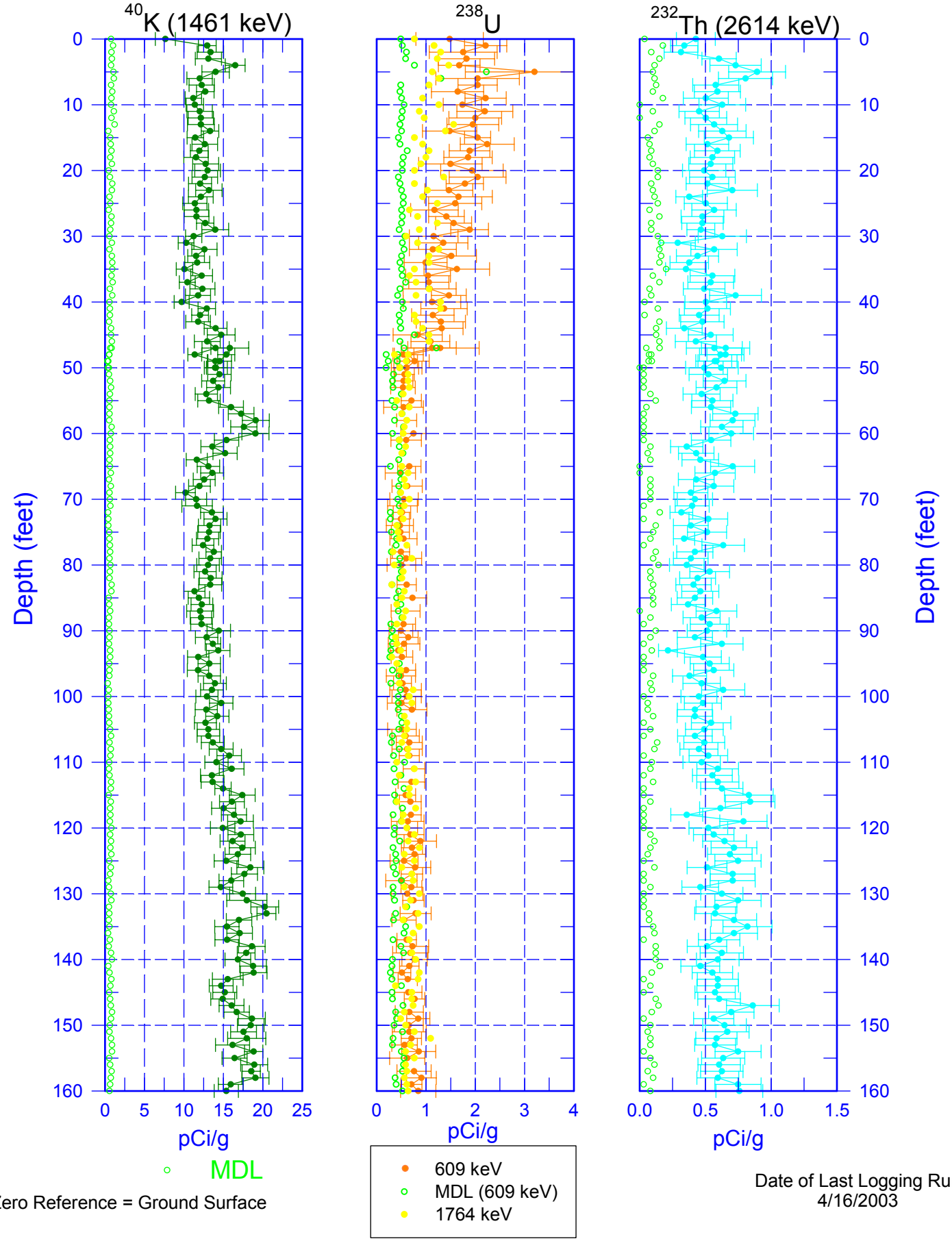
Man-Made Radionuclides



Zero Reference = Ground Surface

Date of Last Logging Run
4/18/2003

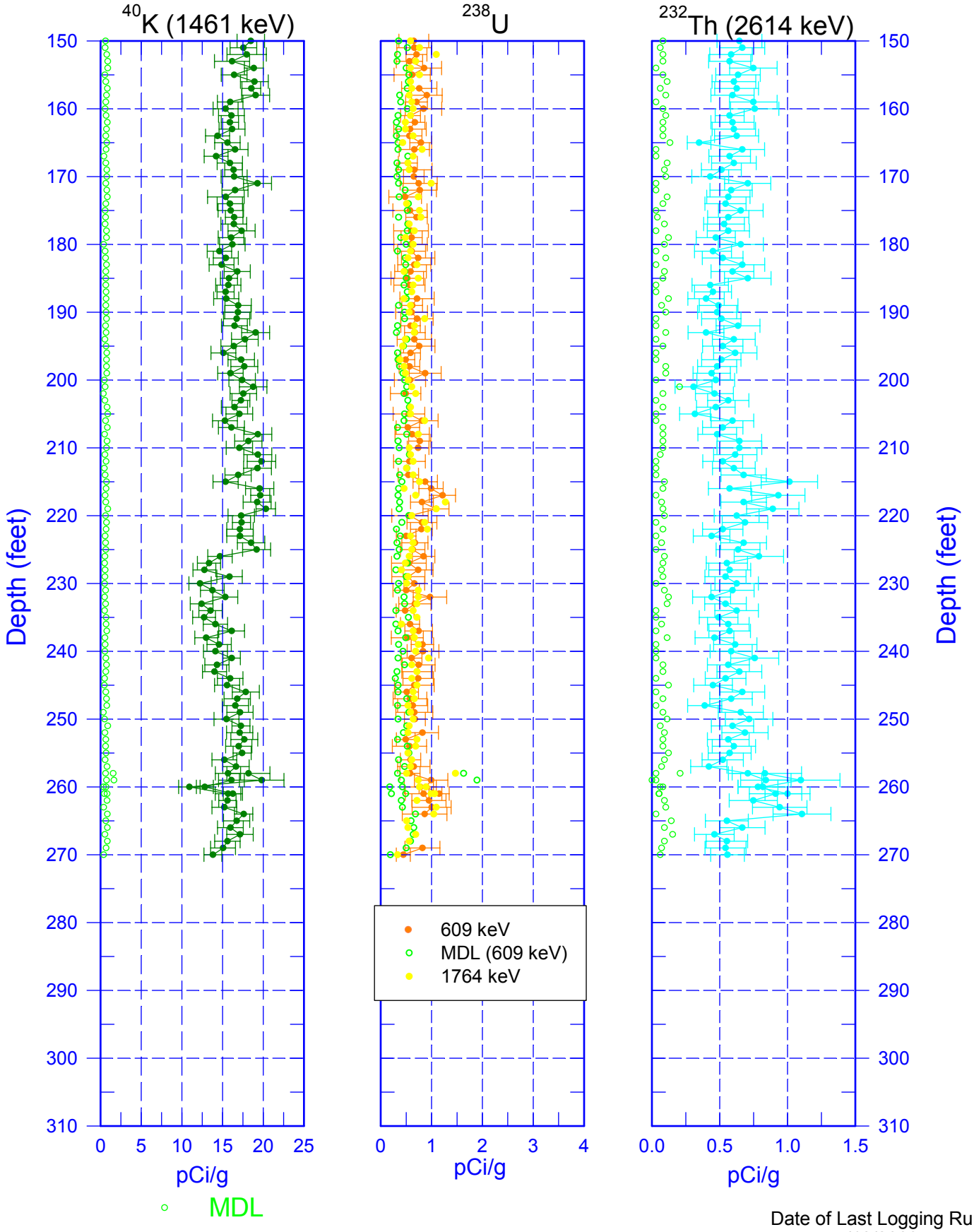
299-E25-XX (B8826)
Natural Gamma Logs



Zero Reference = Ground Surface

Date of Last Logging Run
4/16/2003

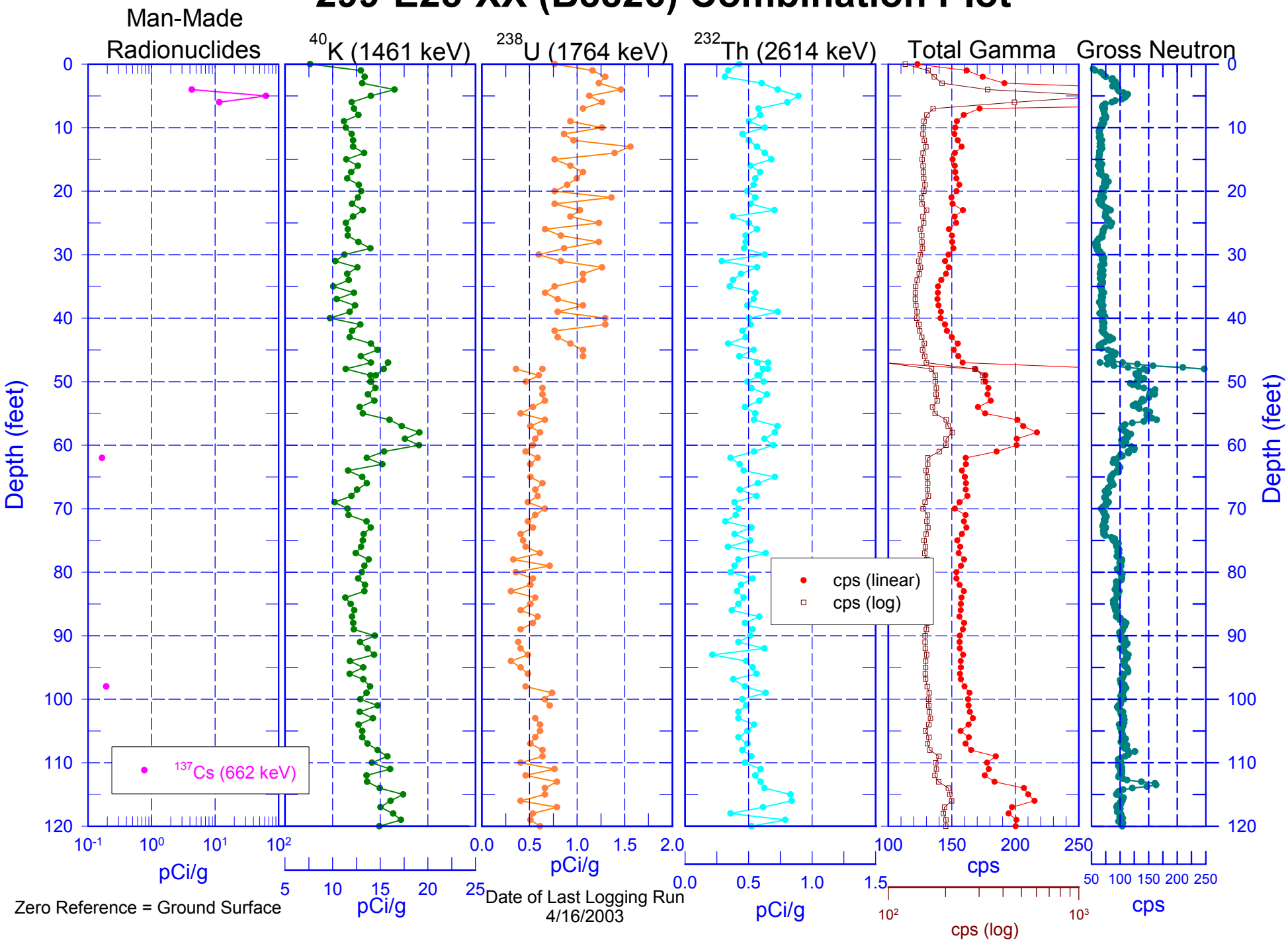
299-E25-XX (B8826)
Natural Gamma Logs



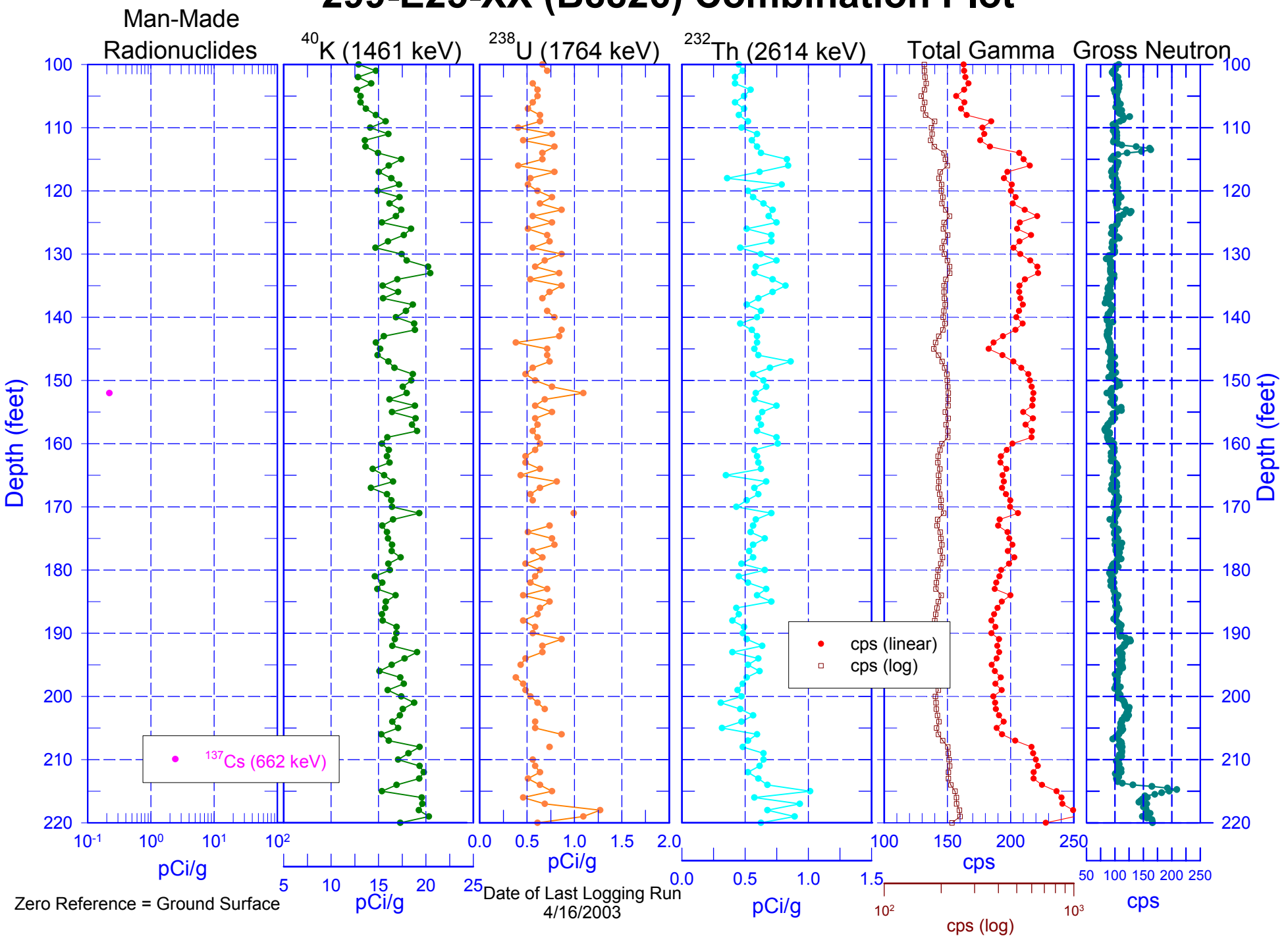
Zero Reference = Ground Surface

Date of Last Logging Run
4/18/2003

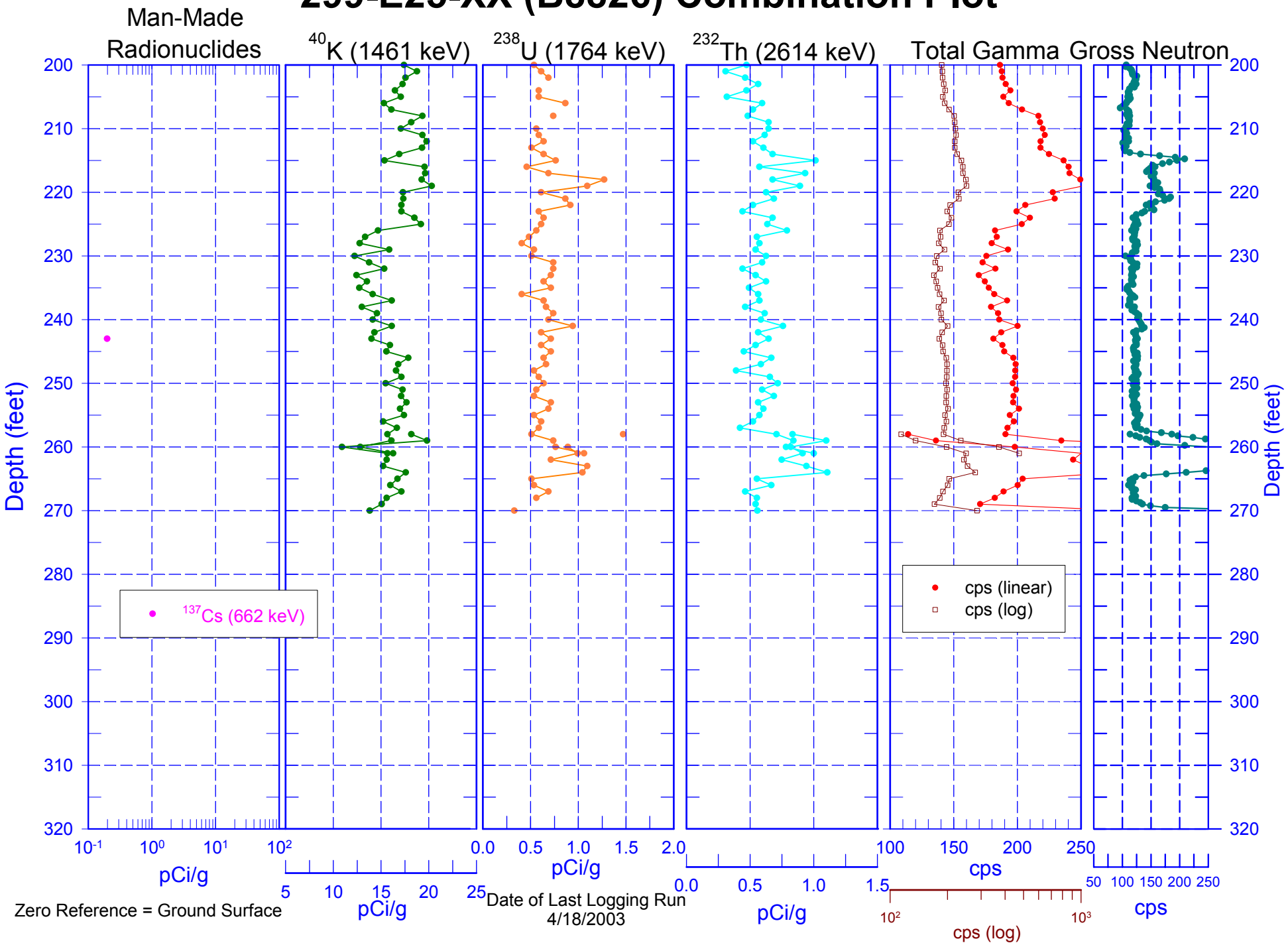
299-E25-XX (B8826) Combination Plot



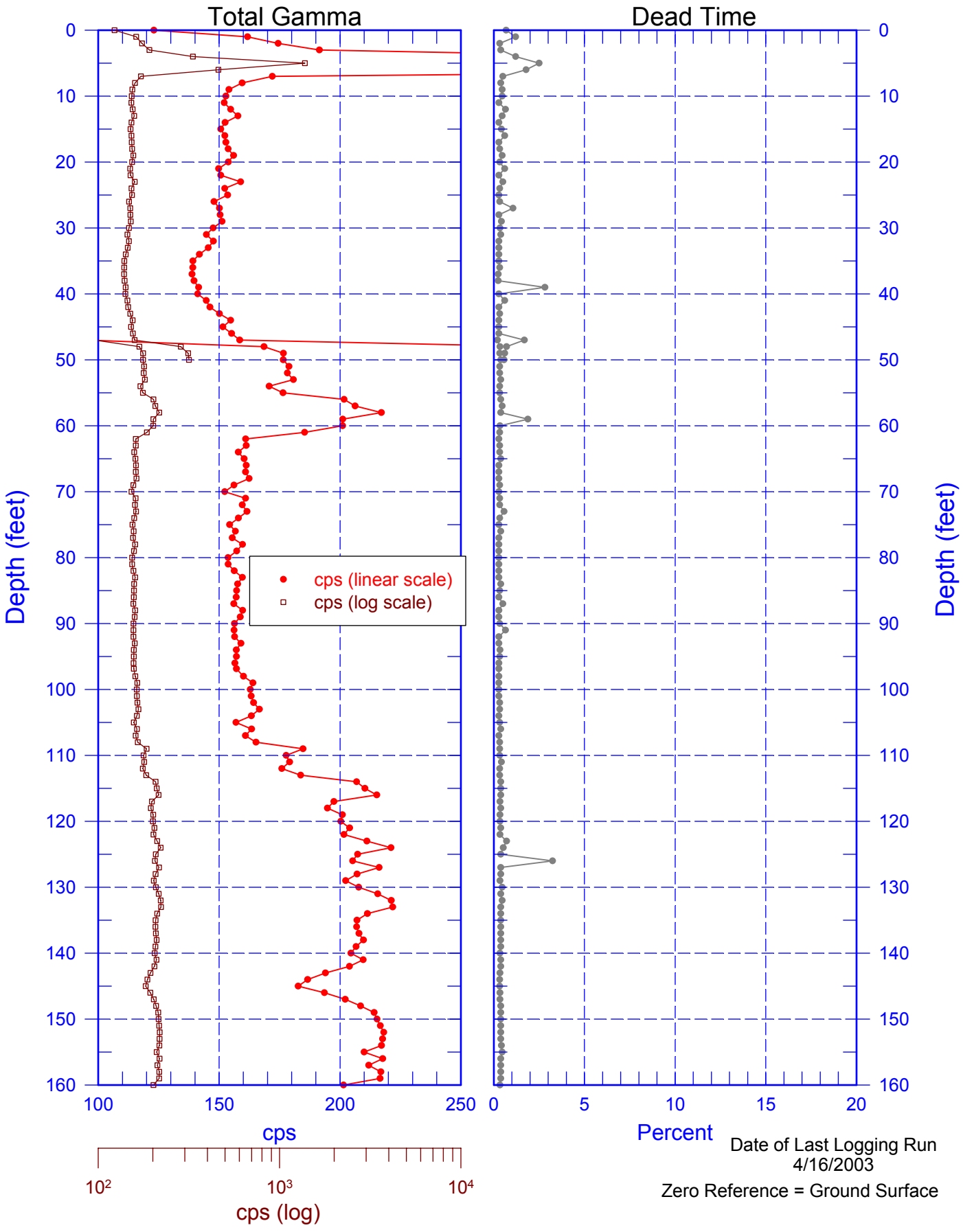
299-E25-XX (B8826) Combination Plot



299-E25-XX (B8826) Combination Plot



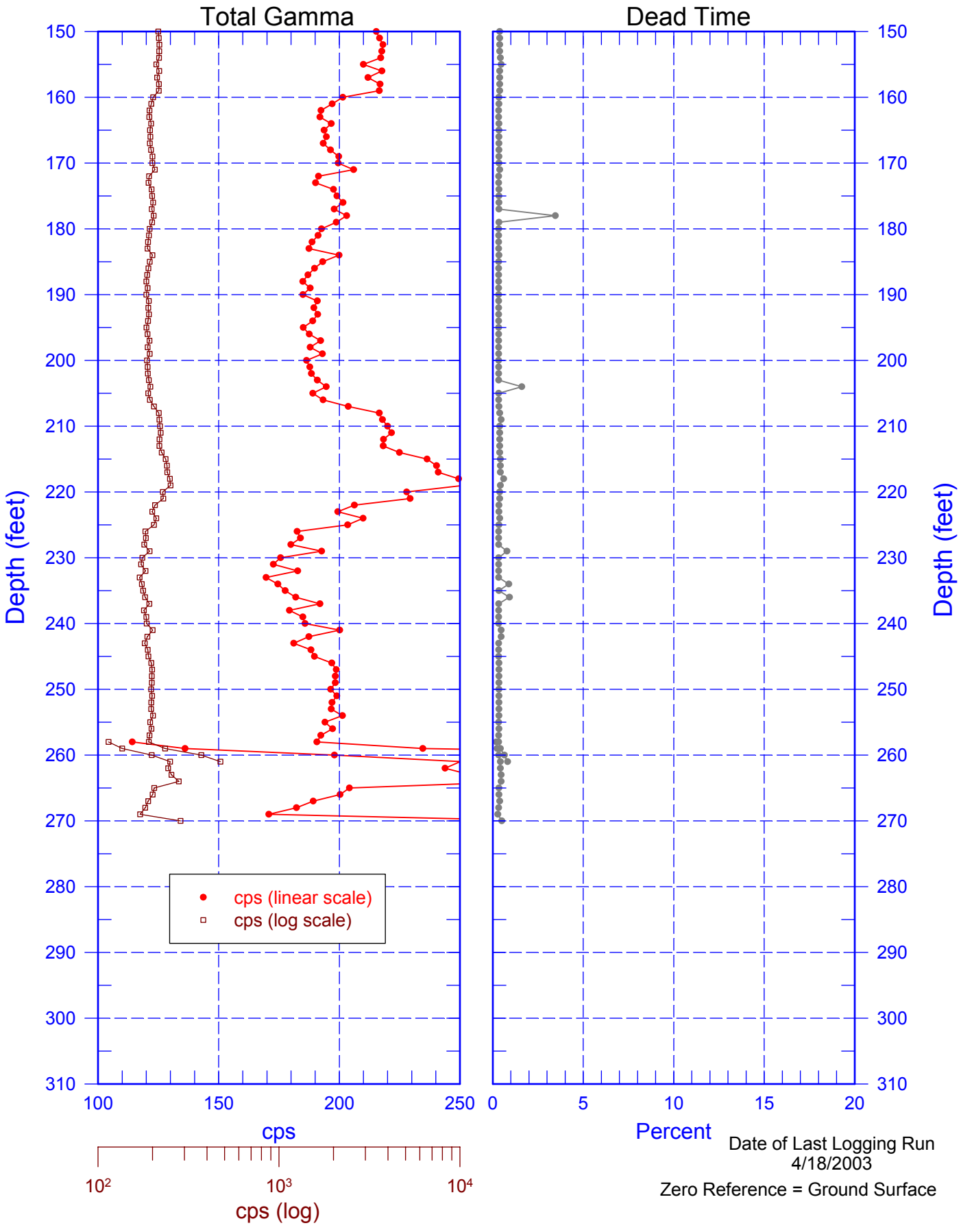
299-E25-XX (B8826)
Total Gamma & Dead Time



Date of Last Logging Run
4/16/2003

Zero Reference = Ground Surface

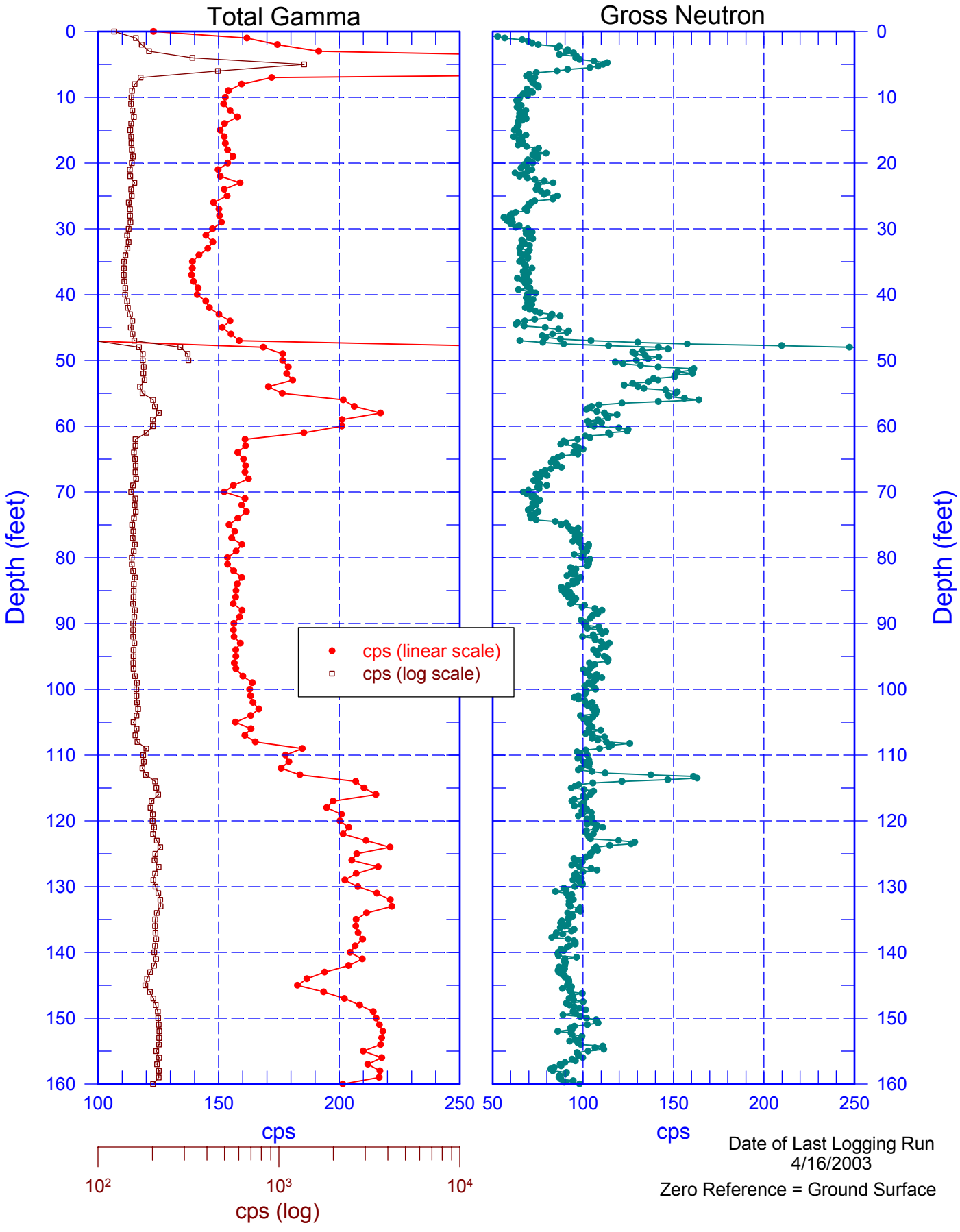
299-E25-XX (B8826)
Total Gamma & Dead Time



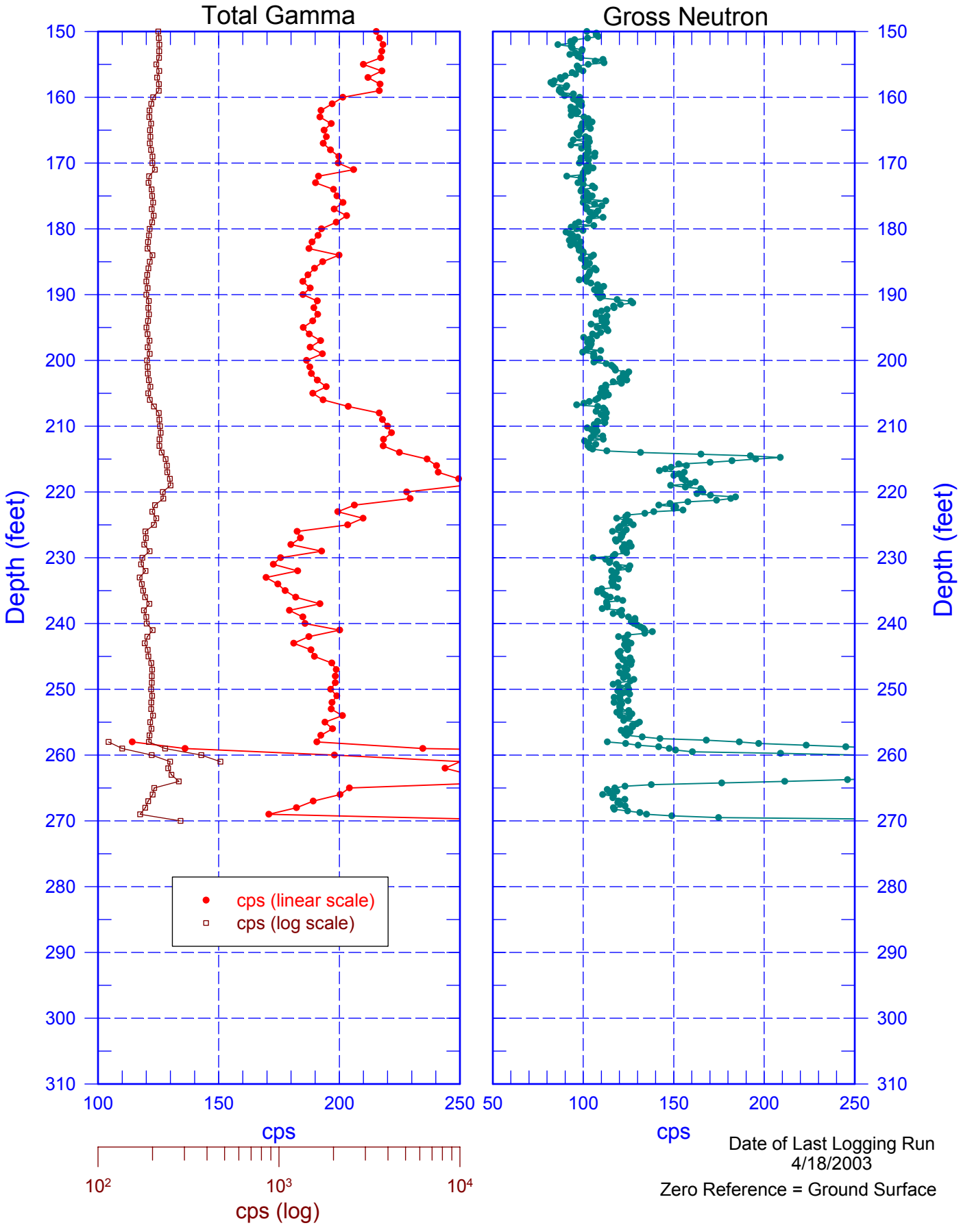
Date of Last Logging Run
4/18/2003

Zero Reference = Ground Surface

299-E25-XX (B8826)
Total Gamma & Neutron



299-E25-XX (B8826)
Total Gamma & Neutron

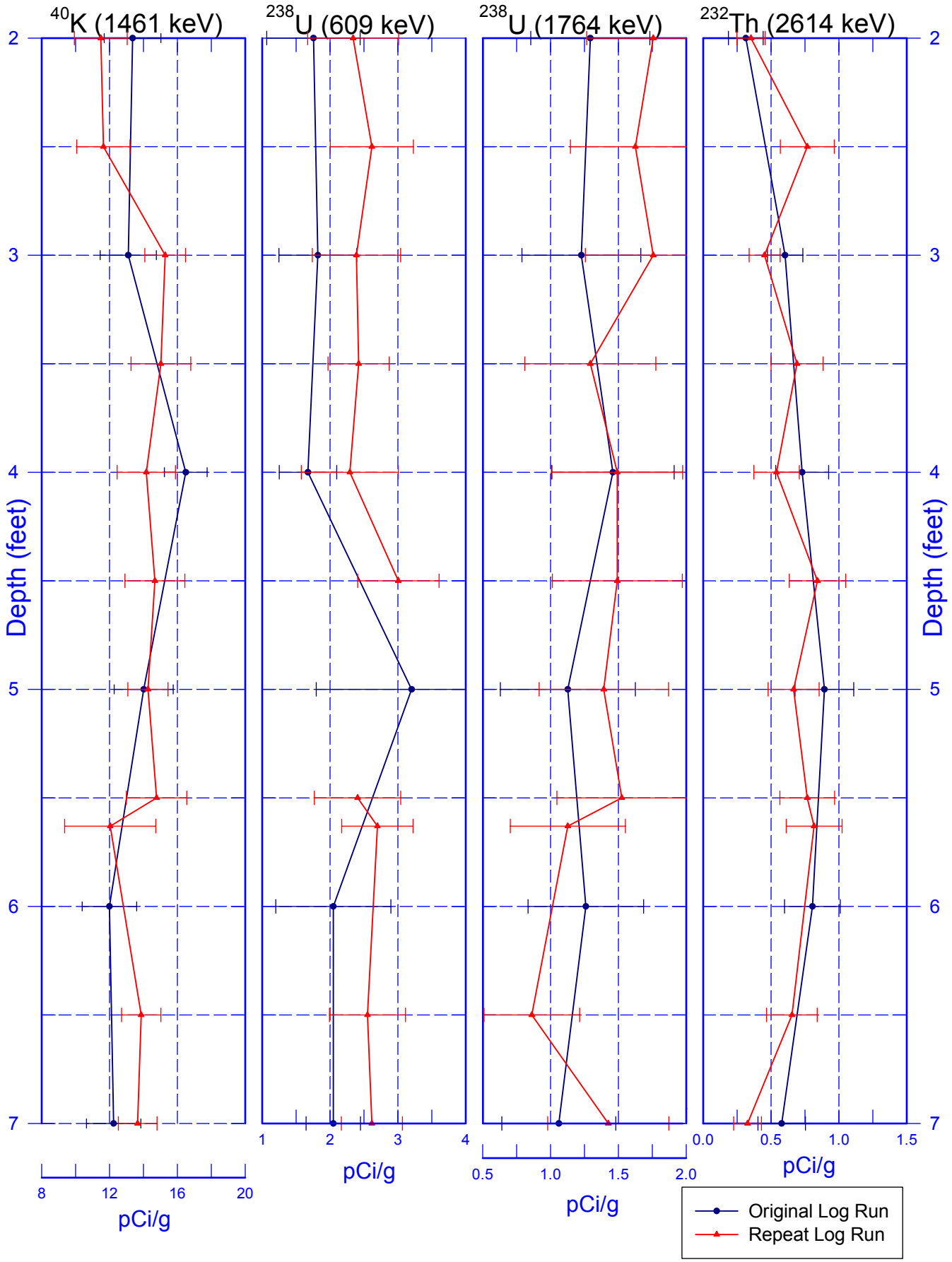


Date of Last Logging Run
4/18/2003

Zero Reference = Ground Surface

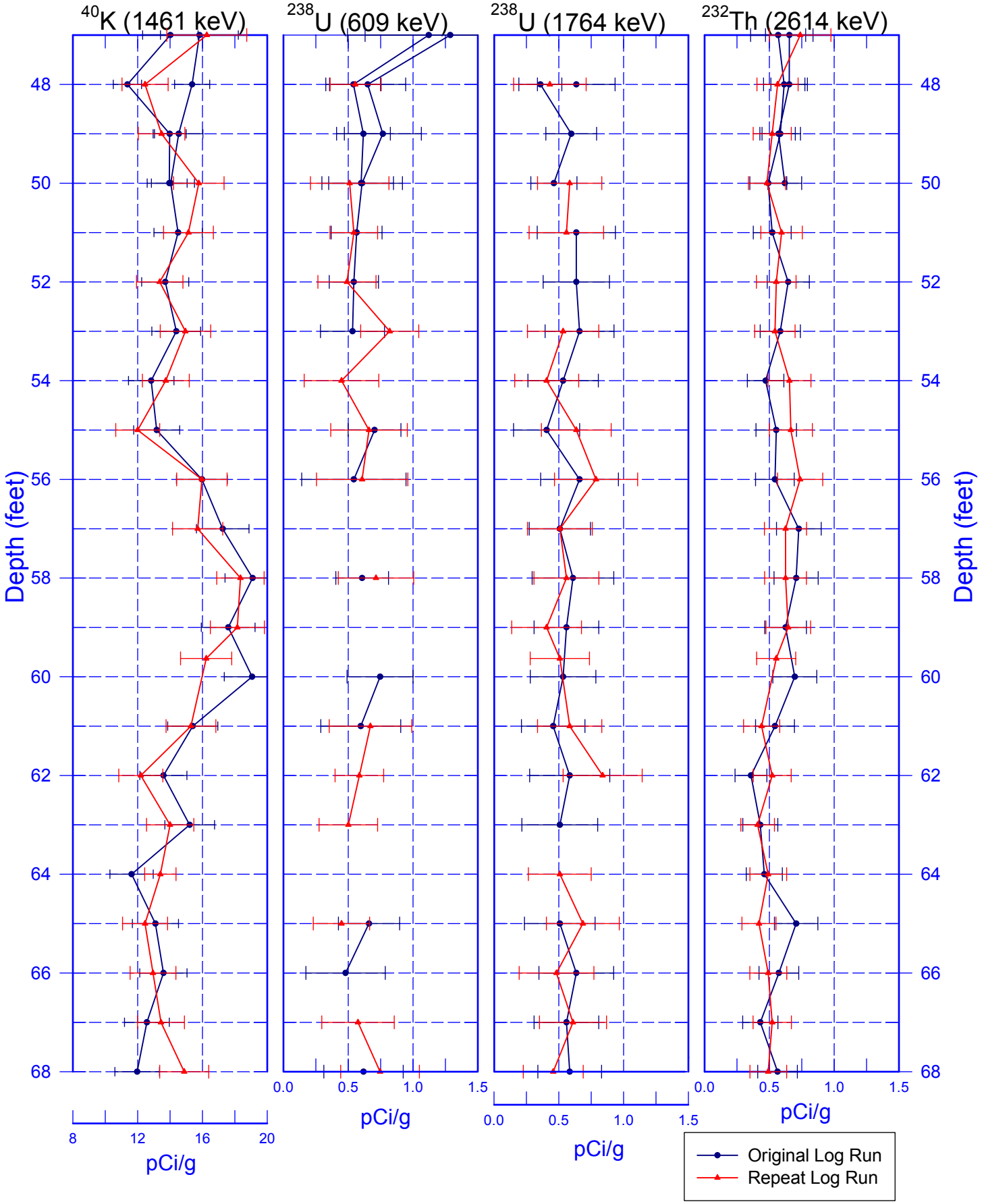
299-E25-XX (B8826)

Rerun of Natural Gamma Logs (7.0 to 2.0 ft)



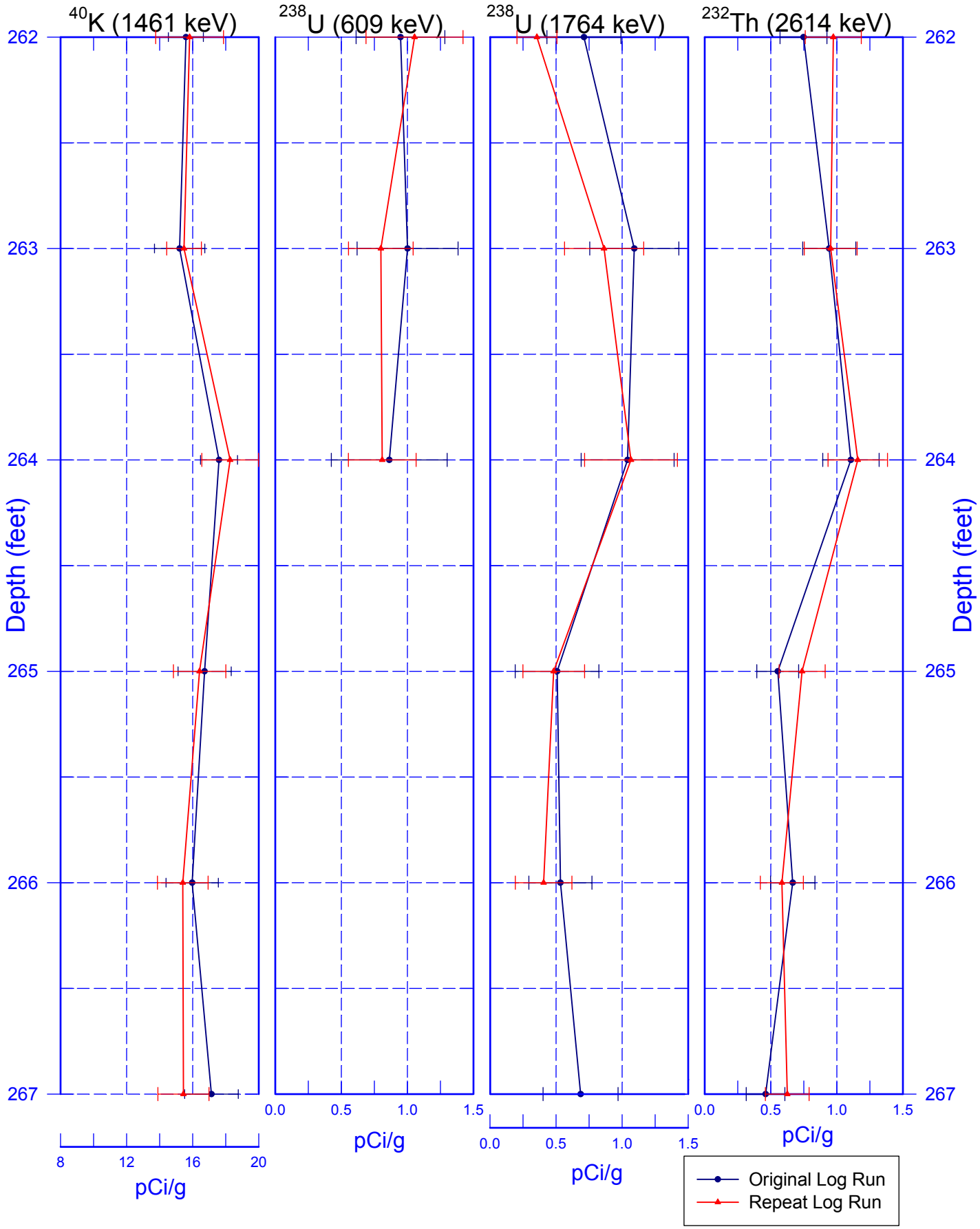
299-E25-XX (B8826)

Rerun of Natural Gamma Logs (68.0 to 47.0 ft)



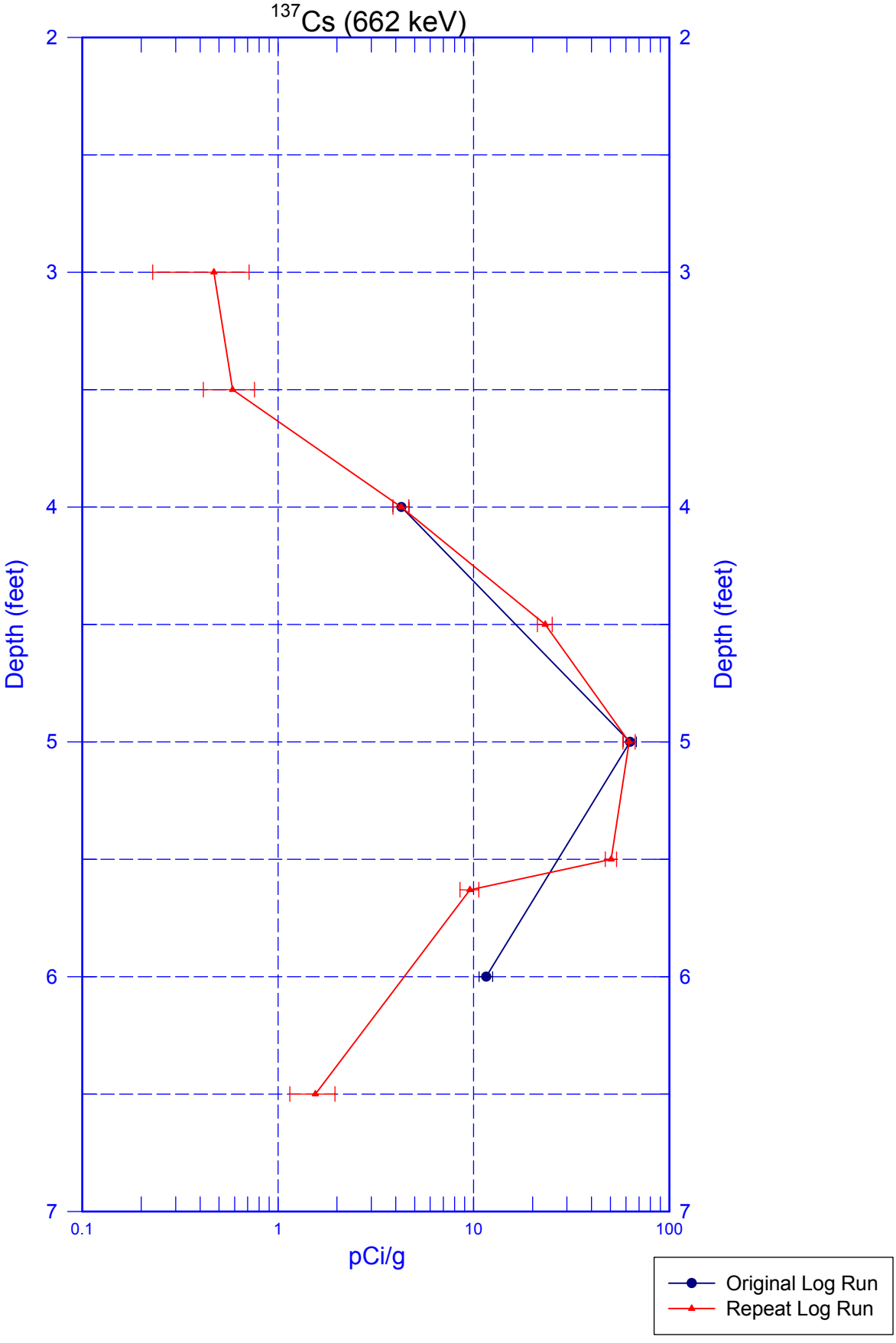
299-E25-XX (B8826)

Rerun of Natural Gamma Logs (267.0 to 262.0 ft)



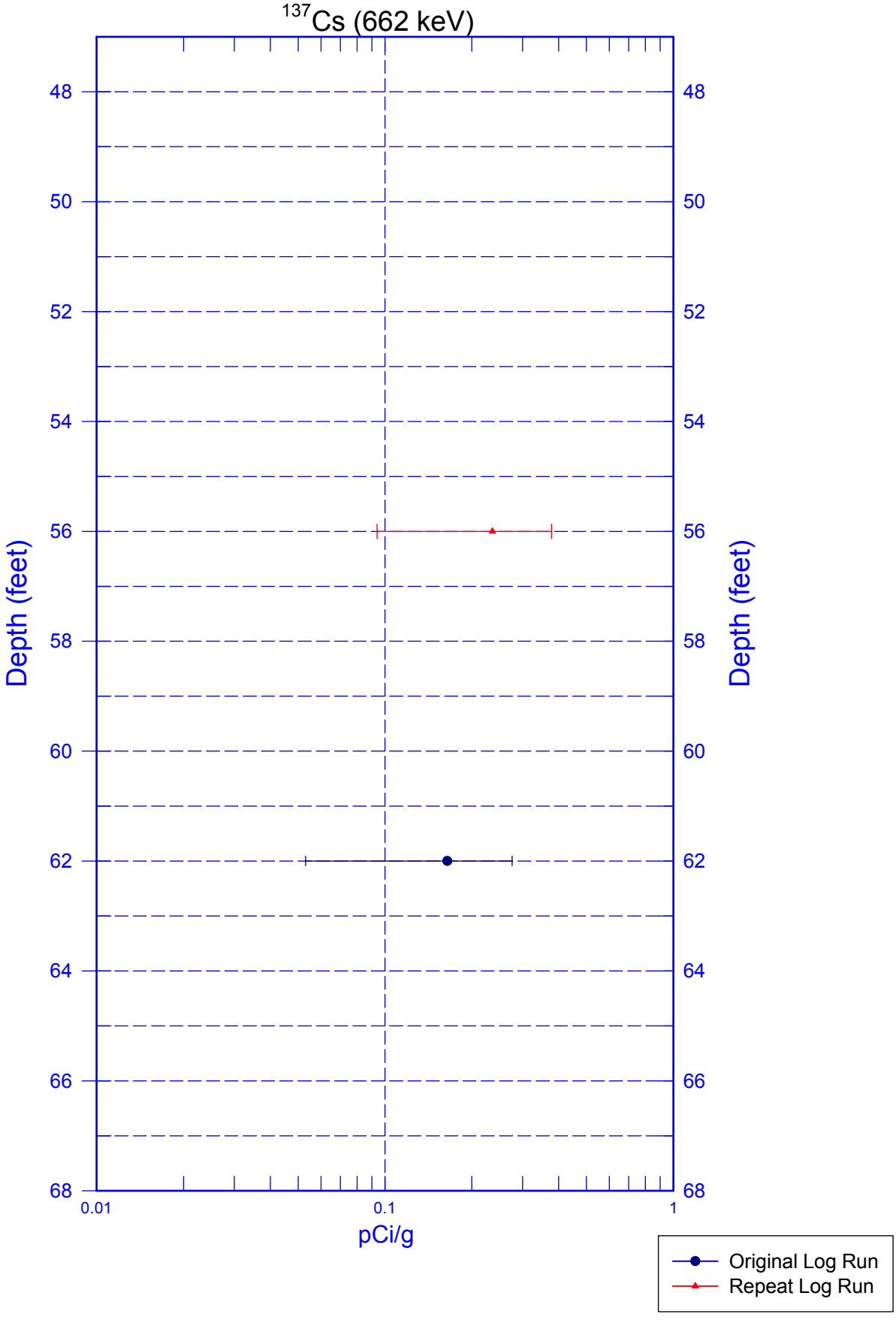
299-E25-XX (B8826)

Rerun of Man-Made Radionuclides (7.0 to 2.0 ft)



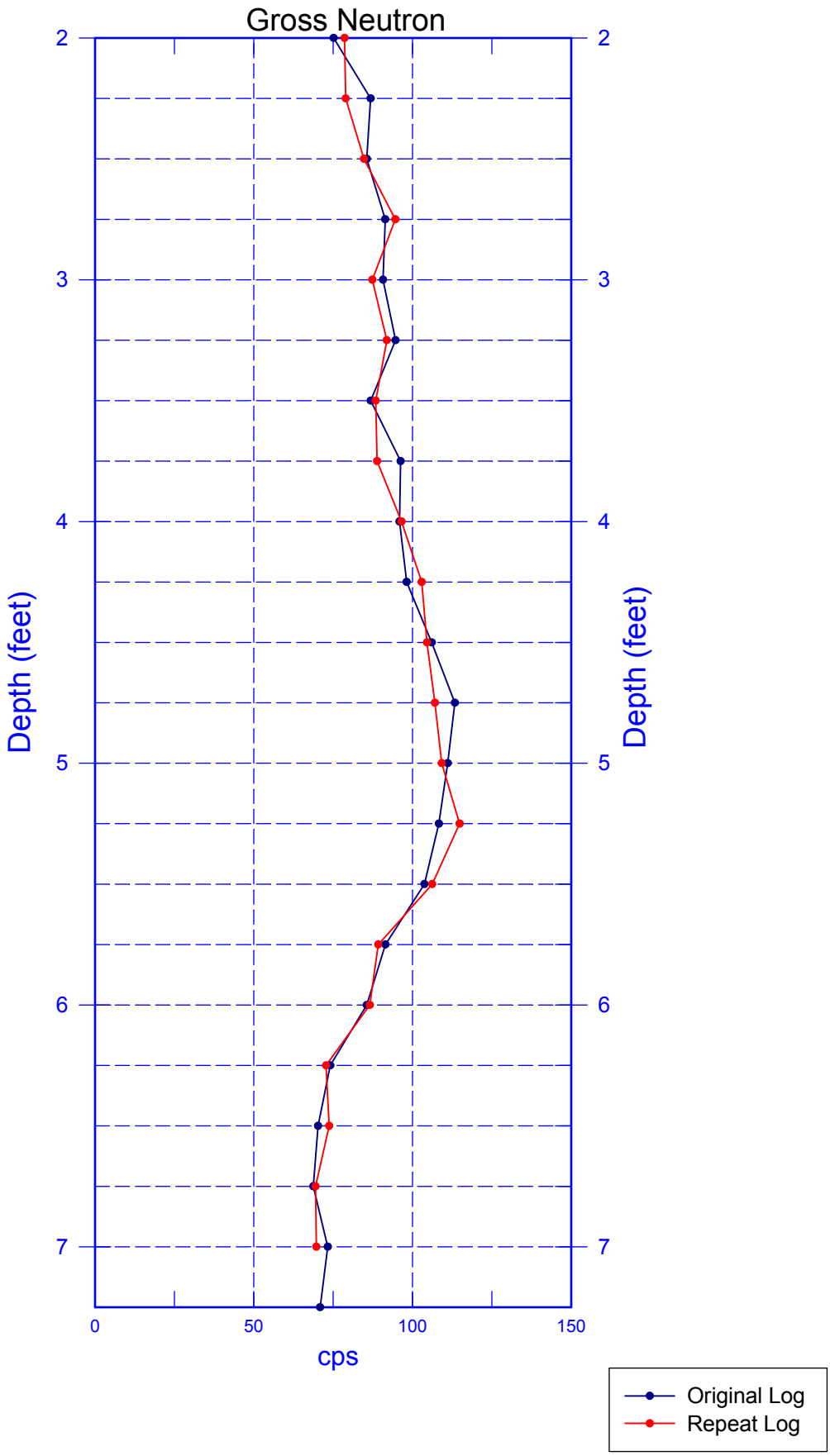
299-E25-XX (B8826)

Rerun of Man-Made Radionuclides (68.0 to 47.0 ft)



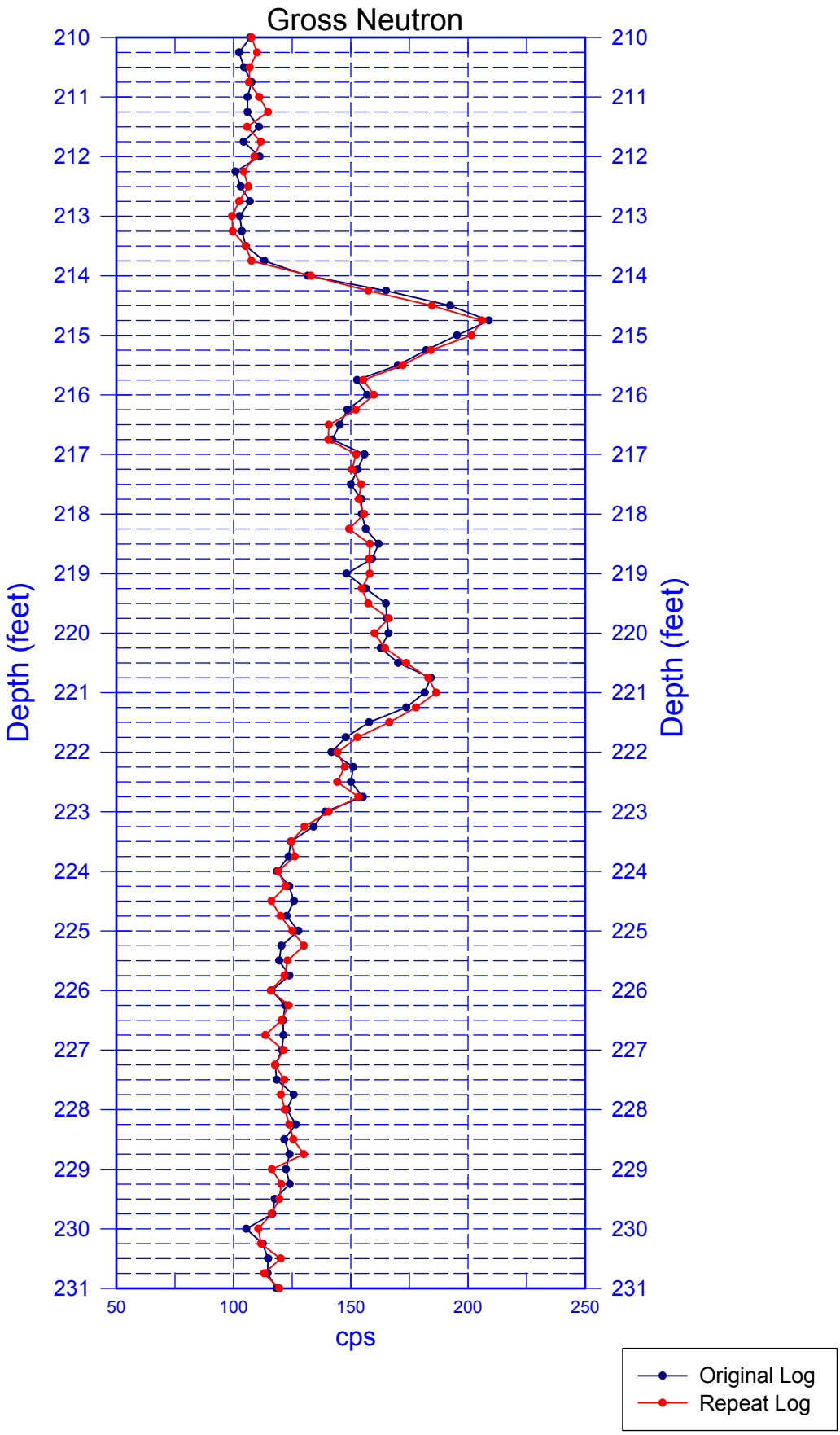
299-E25-XX (B8826)

Rerun of Neutron-Moisture Log (2.0 to 7.25 ft)



299-E25-XX (B8826)

Rerun of Neutron-Moisture Log (210.0 to 231.0 ft)



299-E25-XX (B8826)

Rerun of Neutron-Moisture Log (262.0 to 267.0 ft)